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INQUIRY FROM: Datamation

ENCLOSURE: SD 10/20 technical information

DATE: 12/14/65

Mr. T. Nelson
Sys. Consultant
Box 1546
Poughkeepsie, New York

Your
local
representative

SYSTRON  DONNER
CORPORATION

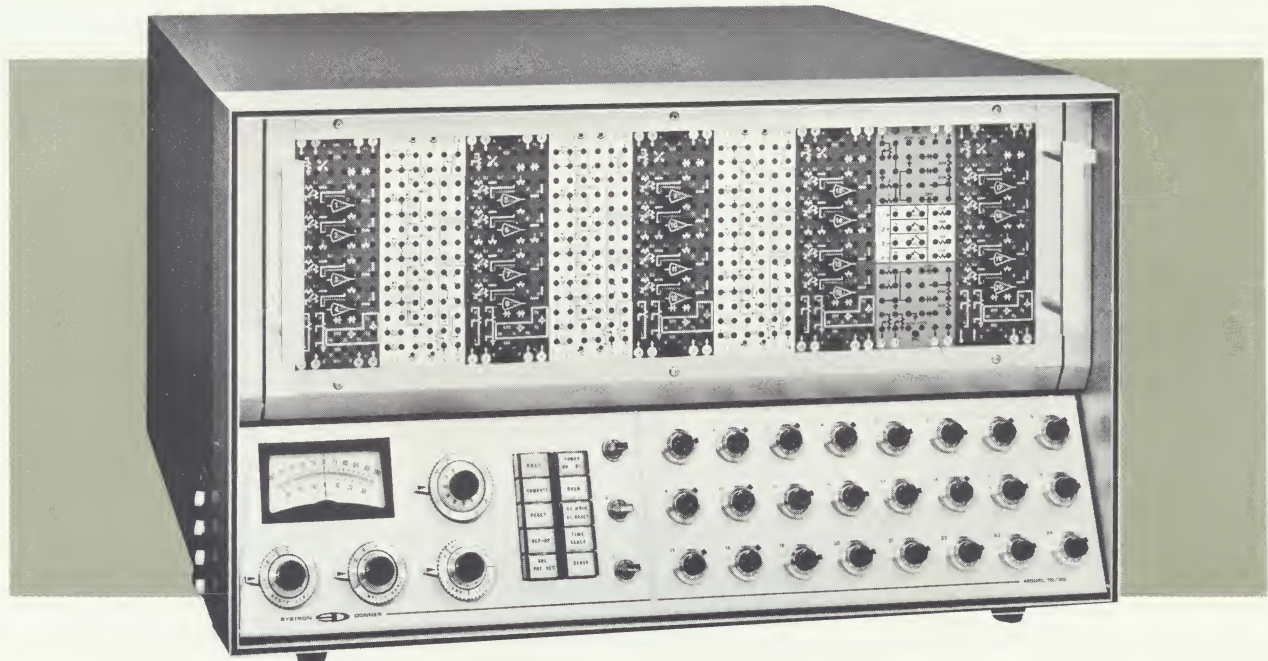
We hope you find the attached information informative and helpful. For your convenience, more engineering data and equipment demonstration can be obtained by contacting your nearest Systron-Donner engineering representative (listed below), who can provide you with valuable assistance and prompt, efficient service. Should you desire to contact us directly at the factory, please write or . . .

call: Mr. James Cunningham

BURLINGAME ASSOCIATES
510 So. Fulton Avenue
Mount Vernon, New York

*New
Portable
Analog Computer*

SD 10/20



A MODERN ± 100 VOLT COMPUTER

In 13 years since the first portable Donner computer was announced, over 1000 computers have been installed. Each year brought new improvements — chopper stabilized amplifiers, first classroom computer, first solid state ± 100 volt amplifiers, iterative computing mode, and others. Now the MODERN analog computer is available — the Systron-Donner 10/20.

Designed for the maximum in problem-solving capability in a small, expandable analog computer, the new SD 10/20 is the first true portable computer to offer a full ± 100 volt operating range. In addition to the basic 100 volt design, the SD 10/20 has been carefully engineered to match the larger, sophisticated computers in problem set-up,

checking and operation. This new computer thus brings to the engineering lab, classroom, and research facility the opportunity to utilize a small, portable computer that uses the same powerful solution approach to problems within the scope of analog computation as the big computers.

DONNER'S EXPERIENCE LEADS THE WAY —

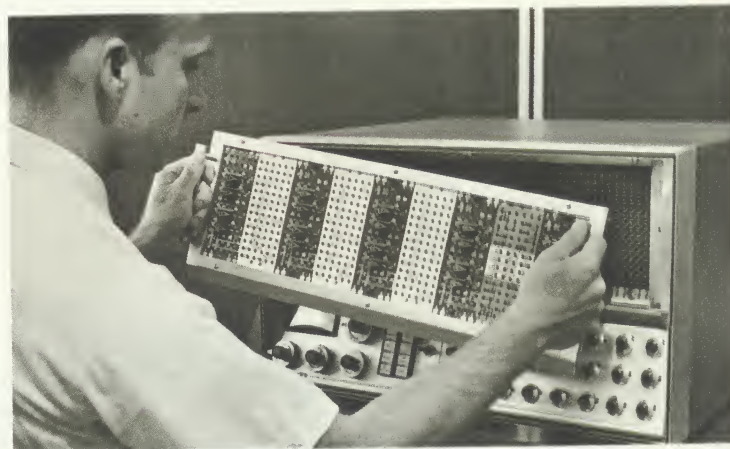
- ★ ± 100 volt design, fully transistorized
- ★ Removable problem board with visual computer circuits
- ★ Patchable electronic mode control
- ★ Patchable integrator time scales
- ★ Full iterative controls, 100 cps REP-OP

REMOVABLE PROBLEM BOARD, consisting of color-coded modular panels, couples directly into computing modules which are housed in a universal, pre-wired patchbay. This close, direct coupling between patch terminals and computing modules provides decrease in amplifier cross-coupling and lower system noise.

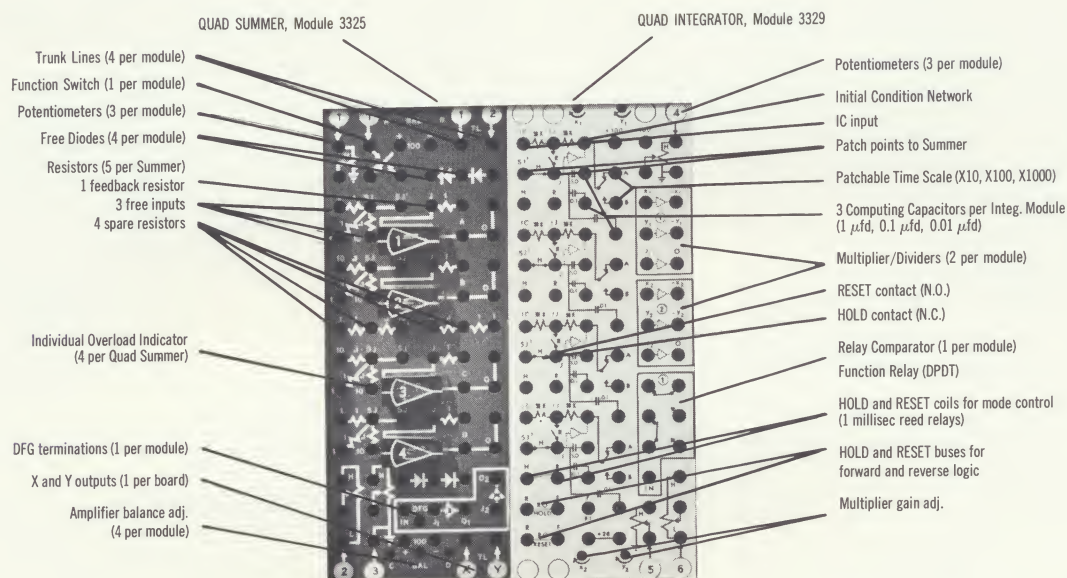
VISUAL COMPUTER CIRCUIT. All computer patch terminals are arranged into visual circuit diagrams thus matching the computer textbooks.

CAPACITY of 20 amplifiers, 16 integrators, 8 multipliers, 4 comparators, 24 potentiometers, and 4 variable diode function generators.

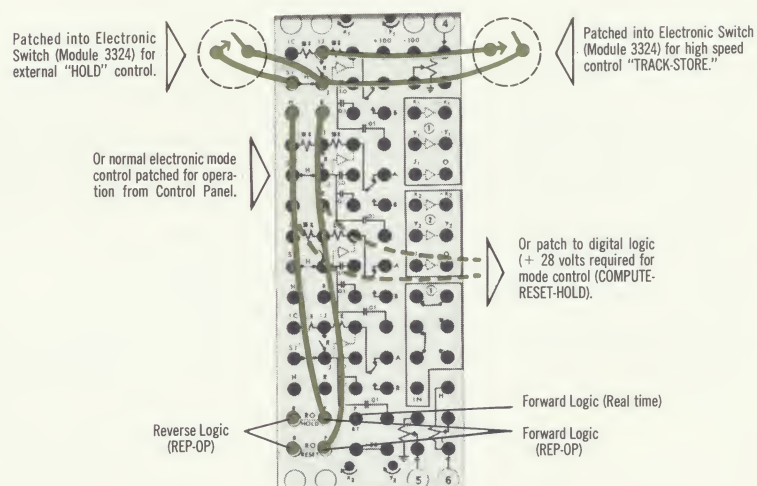
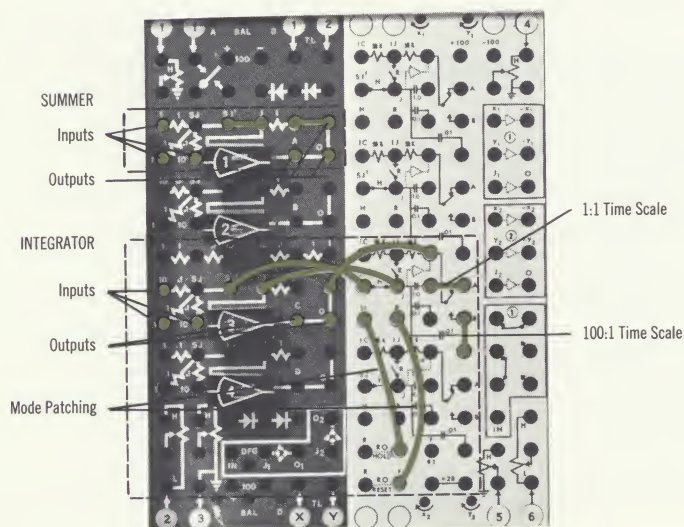
FOOL-PROOF PROBLEM BOARD. The power supply and all amplifiers are voltage and current limited. No blowing out of components when accidental shorts occur.

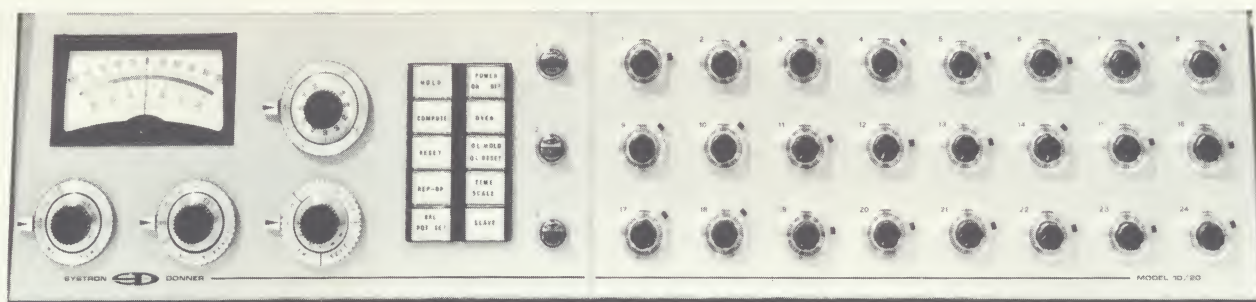


BASIC COMPUTING MODULES



SIMPLICITY AND FLEXIBILITY IN PATCHING COMPUTER CIRCUITS





CONTROL PANEL

The SD 10/20 Control Panel puts at the operator's fingertips all the controls (pushbuttons, concentric selectors, switches) to facilitate rapid readout of problem variables, selection of

computer operating mode, and setting of compute time. The right side of the control panel provides for up to 24 coefficient potentiometers.

MODE SELECTION—by lighted pushbuttons

HOLD — places problem solution on all integrators into hold position simultaneously (within 1 msec).

COMPUTE — applies problem voltages to all integrators simultaneously (within 1 msec).

RESET — applies initial condition voltages to integrators simultaneously (within 1 msec).

REP-OP — places integrators into a repetitive operation cycle. (Compute time variable from 5 msec to 10 sec.)

BAL/POT SET — disconnects junction and grounds the summing junction of all integrator and summer amplifiers. Each amplifier is converted to a gain of 2500 for accurate indication of junction offset.

POWER ON/OFF — energizes and de-energizes computer.

OVEN — indicates +28 volt oven power is on to maintain constant temperature of computing capacitors.

OL HOLD, OL RESET — lights up when any amplifier is overloaded. When depressed, computer goes into HOLD; when released, normal operation is resumed.

TIME SCALE — activates relays in each integrator module to change capacitor across amplifier. (x 10, x 100, x 1000, depending on patchpanel connections.)

SLAVE — permits operation of computer control circuitry from a second console.

READOUT AND ADDRESS SELECTION

PANEL METER — for reading out amplifier outputs, potentiometer arms, potentiometer coefficients, and all mul-

tiplier and function generator outputs by selecting the appropriate amplifier. Meter reading ranges are 1, 3, 10, 30, 100, and 300 volts, and $\pm$ null. Full scale accuracy is 2%. Null position provides 0.02% F.S. resolution with reference potentiometer having a $\pm 0.05\%$ linearity at 25°C.

ADDRESS SELECTOR (concentric) — address capability of 20 amplifiers and 24 potentiometers.

READOUT SELECTOR (concentric) — provides rapid choice of readout at: Panel Meter, External (oscilloscope, x-y plotter, DVM), and +Null and -Null.

METER RANGE SELECTOR (concentric) — with positions for 300 v, 100 v, 30 v, 10 v, 3 v, and 1 v. Serves also as sensitivity adjustment for $\pm$ null.

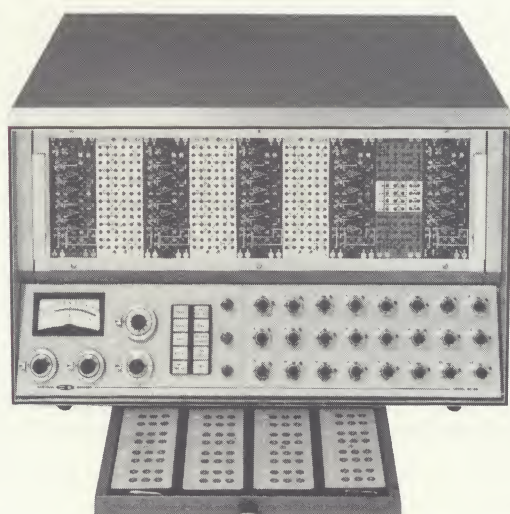
COMPUTE TIME SELECTOR (concentric) — compute time continuously variable 5 msec to 10 sec. Reset time varies from 5 msec to 5 sec, depending upon compute time selected.

FUNCTION SWITCHES

Three single-pole, double throw switches, with terminations on the Quad Summer Modules, provide manual switching flexibility in problem solutions.

POTENTIOMETER PANEL

Maximum capacity: 24 potentiometers, available in groups of 6. Choice of either 10-turn wire-wound potentiometers or single-turn carbon potentiometers for economy.



VARIABLE DIODE FUNCTION GENERATOR GROUP

FOUR VDFG CARDS are mounted on a slide-out tray below the Control Panel. Each FG card contains 12 independent segments, all have screwdriver pot adjustment for break point and slope. Each FG channel terminates on a Quad Summer Module.

TYPICAL EQUIPMENT COMPLEMENT

The Basic SD 10/20 is completely wired to accept a full complement of computing modules. Changing and expanding the module complement is accomplished merely by inserting additional computing modules (up to 9) into the pre-wired patchbay.

Item	Quantity
Cabinet with complete Control Panel, reference system, power supply, pre-wired patchbay	1
Quad Summers, Module 3325	5
Quad Integrators, Module 3329 (Dual Multiplier & Comparator)	4
Potentiometer Group, Model 3374 (6 potentiometers in each group)	4
Variable Diode Function Generators, Model 3351	4

SPECIFICATIONS

DUAL OPERATIONAL AMPLIFIER, Model 3310 (2 Model 3310 plug-in cards in each Module 3325 Quad Summer)

Maximum Output Voltage	± 105 volts (1 ma)
Output Voltage (at ± 25 ma)	± 100 volts
Maximum Output Current (at $\pm 100v$)	± 25 ma
Overall DC Gain	$> 10^7$
Summing Junction Offset	$< 100 \mu V/8$ hours

INTEGRATORS (Part of Module 3329)

Reset Relays (Reed type) & Hold	Operate time 0.5 msec (typical) 1 msec (max) Differential operate time 0.2 msec (typical) 0.5 msec (max)
Integrator Drift ($R_{in} = 1M$, $C_{fb} = 1 \mu f$)	$\pm 20 \mu V/sec$ max.
Noise at Output (with $C_{fb} = 1 MF$)	< 5 mv (PP)

SUMMERS (Module 3325)

Bandwidth ($R_{in} = R_{fb} = 100K$, no capacitive loading at summing junction or output)	> 200 kc (typical overshoot of 1.0 db)
Bandwidth ($R_{in} = R_{fb} = 1M$)	> 50 kc (typically no overshoot)
Velocity Limit	$> 3 \times 10^6$ v/sec
Noise at Output ($R_{in} = R_{fb} = 1M$ with R_{in} grounded)	10 mv (PP) (to 100 kc)
Phase shift at 100 cps ($R_{in} = R_{fb} = 100K$)	< 0.03

INPUT & FEEDBACK COMPONENTS

Feedback capacitors of $1 \mu f$ and $0.1 \mu f$ values to within $\pm 0.02\%$.
Feedback capacitors of $0.01 \mu f$ accurate to better than $\pm 1\%$.
$1 \mu fd$ and $0.1 \mu fd$ capacitors mounted in an oven with ± 1 degree C temperature regulation to reduce inherent dielectric changes with temperature.
Temperature coefficient of 0.01% resistors less than ± 5 ppm per degree C.
Input and feedback resistors matched to $\pm 0.01\%$.

QUARTER SQUARE MULTIPLIERS (Part of Module 3329)

Maximum static error: Less than 100 mv.
Zero Offset: $X = Y = 0 \rightarrow 20$ mv X or $Y = 0 \rightarrow 60$ mv.
Frequency Response: Down no more than 3 db at 50 kc.
Drift: Less than 25 mv for 8 hours at constant temperature, $X = Y = \pm 100$. Less than 5 mv/8 hours, $X = Y = 0$.
Noise: 20 mv (PP) (0 to 100 kc).
Phase Shift: Less than 0.05° at 100 cps and less than 0.5° at 1000 cps.
Input and output signal voltage ranges: ± 100 volts.

DIODE FUNCTION GENERATORS, Model 3351

Noise: < 100 mv (PP) for worst possible conditions; high slope settings and all diodes conducting.
Amplitude Response: Flat to 1 kc.
Phase Shift: $< 1^\circ$ at 100 cycles (when using an operational amplifier output).
Input Impedance: $> 45k$ ohm.

Each function generator card has 12 diode segments (12 slopes and 12 break points). Two FG cards can be paralleled for 24-segment function generation.

Amplifiers required by the function generators are available at the patch board in the Quad Summer Modules. Each diode segment is capable of providing a 2:1 slope change.

Setting of the function is possible by adjusting the appropriate potentiometers while reading out the actual break point and ordinate values.

COEFFICIENT POTENTIOMETERS, Model 3374

Linearity error	$< \pm 0.25\%$
Resolution	$< 0.013\%$
Power Rating	2.5 watts (at $40^\circ C$)
End Resistance	< 10 ohms
Nominal Resistance	30k ohms

PHYSICAL DESCRIPTION

Dimensions: 24" wide, 15" high, 25" deep.
Weight: 125 lb. approx. (fully expanded).
Power Consumption: 350 watts (fully expanded).
Power Source: Connections provided for 115v, 220v, 230v, 240v, 250v, $\pm 10\%$, 50-400 cps.

SYSTRON-DONNER ENGINEERING REPRESENTATIVES

NORTH and CENTRAL ATLANTIC

Burlingame Associates
510 South Fulton Avenue, Mount Vernon, New York
Tel: MO 4-7530
8218 Wisconsin Avenue, Washington 14, D.C.
Tel: OL 4-6400
106 Pickard Bldg., East Mallory Road, Syracuse 11, N.Y.
Tel: 454-2408
7 Wellington Street, Waltham, Massachusetts
Tel: TW 4-1955
222 Long Lane, Upper Darby, Pennsylvania
Tel: JA 8-6080

SOUTH ATLANTIC

E. G. Holmes Associates
3667 Clairmont Rd., N.E., Chamblee, Georgia
Tel: 451-6161
316 1/2 South Bumby Street, Orlando, Florida
Tel: CH 1-2128
430 W. Gaston St., Greensboro, North Carolina
Tel: BR 2-9855
915-F Franklin St. S.E., Huntsville, Alabama
Tel: 539-1114

MIDWEST

S. Sterling Co.
21250 10 1/2 Mile Rd., Southfield, Mich.
Tel: 442-5656
5827 Mayfield Rd., Cleveland 24, Ohio
Tel: HI 2-8080
3300 S. Dixie Dr., Dayton 39, Ohio
Tel: AX 8-7573
4232 Brownsville Rd., Pittsburgh 27, Penn.
Tel: TU 4-5515
7849 N. Lindberg Blvd., Hazelwood, Missouri
Tel: TE 7-1221
Carter Electronics
7203 So. Western Ave., Chicago 36, Illinois
Tel: 776-1601
2401 W. 66th St., Minneapolis 31, Minnesota
Tel: 869-3261
6333 Hollister Dr., Indianapolis 24, Indiana
Tel: AX 3-0696

WEST

Ward-Davis Associates
2425 Mission St., San Marino, California
Tel: 682-3307
1020 Corporation Way, Palo Alto, California
Tel: 968-7116
3492 Pickett St., San Diego, California
Tel: 297-4619
Barnhill Associates
1170 South Sheridan Blvd., Denver 26, Colorado
Tel: 934-5505
319-A Wyoming Blvd., N.E., Albuquerque, New Mexico
Tel: 265-7766
30 Pima Plaza, Scottsdale, Arizona
Tel: 947-5493
Rush S. Drake Assoc.
6133 Maynard Avenue South, Seattle 8, Washington
Tel: PA 5-2700

CANADA

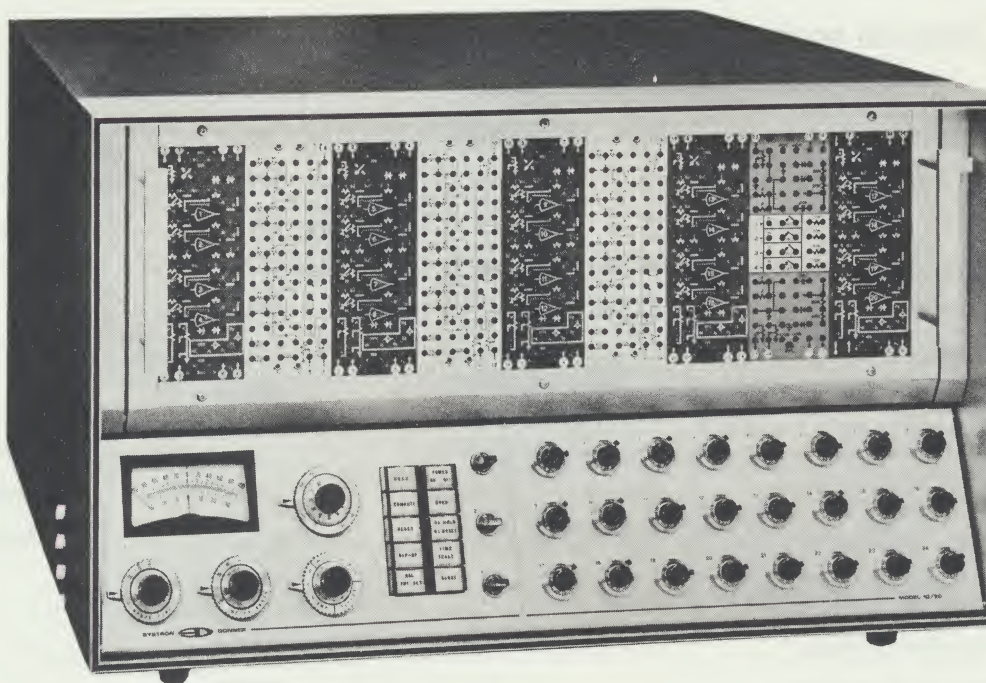
Instronics, Ltd.
P. O. Box 100, Stittsville, Ontario, Canada
Tel: 828-5115

SYSTRON  DONNER
CORPORATION

888 GALINDO STREET • CONCORD, CALIFORNIA
Phone: (415) 682-6161 • TWX 415-687-3200

TRANSISTORIZED $\pm 100V$ ANALOG COMPUTER
PRICE and QUOTATION FORM

SD 10/20



1 SD 10/20 COMPUTER

Cabinet with complete Control Panel, Potentiometer Panel (24 potentiometer capacity), pre-wired module receptacle (9 module capacity), computer power supply and ± 100 volt d.c. reference system.

OVERALL DIMENSIONS: 24" wide, 15" high, 25" deep APPROX. WEIGHT: 100 lbs. (fully expanded)

POWER CONSUMPTION: 150 watts (fully expanded)

POWER SOURCE: Connections provided for 115v, 220v, 230v, 240v, 250v, $\pm 10\%$, 50-400 cps.

PRICE \$ 3,000.00

	UNIT PRICE	QTY.	TOTAL PRICE
1 BASIC SD 10/20 COMPUTER:	\$3,000.00	_____	\$ _____

2 POTENTIOMETER GROUP:

Model 3374 Pot group, 6 ten-turn wire-wound pots with counting dials	\$ 300.00	_____	\$ _____
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Potentiometer TOTAL : _____

3 FUNCTION GENERATOR GROUP:

Model 3351 Variable Diode Function Generator card	215.00	_____	\$ _____
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Function Generator TOTAL: _____

4 COMPUTING MODULES:

Model 3325 Quad Summer	\$1,000.00	_____	\$ _____
Model 3329 Quad Integrator, Dual Multiplier & Comparator	750.00	_____	_____
Model 3320 Dual Integrator Amplifier	700.00	_____	\$ _____
Model 3321 Dual Summer Amplifier	650.00	_____	_____
Model 3322 Dual Inverter Amplifier and Dual Operational Relay	540.00	_____	_____
Model 3323 Dual Inverter Amplifier and Dual Electronic Multiplier	945.00	_____	_____
Model 3324 Dual Inverter Amplifier and Quad Electronic Switch	835.00	_____	_____
Model 3310 Dual Amplifier (spare card)	400.00	_____	_____

Computing Module TOTAL: _____ including _____ Amplifiers, _____ Summers, _____ Inverters, _____ Integrators, _____ Relay Comparators, _____ Electronic Comparators, _____ Multipliers

5 DIGITAL LOGIC CONTROL MODULES:

Model 3326 Flip-Flops	\$ 500.00	_____	\$ _____
Model 3327 Logic Gates	500.00	_____	_____
Model 3328 Time/Event Control	950.00	_____	_____

6 Removable Problem Board	120.00	_____	\$ _____
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7 Patch Cord and Shunt Plug Assortment (100 items)	100.00	_____	_____
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8 Universal Module Extender	100.00	_____	_____
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9 Instruction Manual, A.C. Power Cords and Spare Fuse Kit	1 each		N/C
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10 Special Instructions or assembly requirements: _____

Price for special work (if required) \$ _____

TOTAL PRICE, F.O.B. Concord, California \$ _____

S-D Quotation No: _____

(Please reference this number on all correspondence)

Delivery: _____ days after receipt of Purchase Order

Terms: net 30 days

SYSTRON-DONNER CORPORATION

NOTE: Budgetary prices are subject to change without notice. Signed quotations are firm for a period of 30 days.

Signature _____

Date _____

SD/USA/8-65

SYSTRON  **DONNER**
CORPORATION

888 GALINDO ST., CONCORD, CALIFORNIA, U.S.A.
PHONE: (415) 682-6161 • TWX: 415-687-3200 • CABLE: SYSTRONDONNER

TECHNICAL PROPOSAL

An analog computer is more than just a grouping of amplifiers, potentiometers, integrators, multipliers, function generators, etc. It is a system designed to provide the operator with maximum flexibility in using these components to do simulation or mathematical analysis. Due to the importance of understanding the concept of the system, we would like to highlight for your consideration, the following points that make the Systron-Donner Computer Series, the newest and most flexible mathematical tool on the market.

±100 Volt Operation

Advantages of ±100 volt operation over a ±10 volt system include the following:

1. Compatibility and Slaving to other 100 volt systems.

The industry standard has been ±100 volts for many years and as such, most of the computers in use today are 100 volt.

2. Improved Accuracy and Resolution for non-linear functions.

For Multipliers and Function Generators where diodes are used, the higher the full scale range, the less effect the forward voltage drop characteristics of diodes have. The diodes have a constant voltage error and thus can represent ten times the error for a 10 volt system than a 100 volt system.

3. Signal-to-Noise Ratio Improvement.

Although 100 volt amplifiers typically have more noise than a 10 volt amplifier, it is usually less than a factor of 3 and therefore a 3 to 1 improvement of signal-to-noise can be obtained; i.e., a 10 m.v. peak-to-peak noise level is 80 db for a 100 volt system, but only 60 db for a 10 volt system.

4. No Obsolescence.

The industry standard will continue to be 100 volt and all future developments of significance will be made on 100 volt designs.

Patchboard Simplicity

The patchboards for both the SD 10/20 and 40/80 have been carefully human-engineered for expert and neophyte alike. Very simply stated, "The visual computer circuits make it possible for the Programmer and Operator to be one".

This unique patchboard is ideal for the installations where the computer operator must also do the programming. With the computer circuit very clearly shown, it eliminates the need for memorizing special patching codes or utilizing special and expensive patching cords.

For scientific education, the "circuit approach" on the patchboard provides the student with a direct comparison between programming and the circuits in the text book.

Built-In Hybrid Capability

Three Digital Logic Modules provide hybrid computation as a standard part of the computer.

The design concept of the SD Computer provides the necessary mode control -- flexible Rep-Op capability -- relay and electronic switch comparator circuitry -- forward-reverse logic for all integrators - to make this a very simple expansion.

These digital modules add the flexibility to achieve complete sub-routine control for "Integrator Mode". The unique digital counter can be used as a pre-set timer with multiple outputs, a pre-set event counter with multiple outputs, or a combination of both.

Outstanding Features

No Increase in Size

No separate housing required

No separate patch board required

Computer Can Still be Fully Loaded (using QUAD Summer)

Light for each Flip-Flop (located at Flip-Flop)

Flexible Timing

Each command variable in selected increments to 1000 secs.

Pre-Set Event Counter

Up to 6 decades

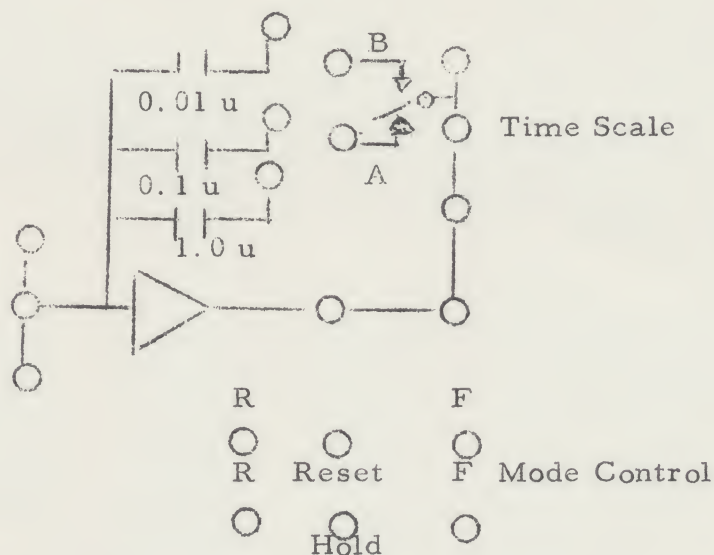
Computer Proposal, p2

The S/D-1 LOG Digital Logic Control Modules follow the same philosophy as the other modules. By using the Model 3325 Quad Summer in conjunction with the various digital logic units, digital capacity in excess of that offered by competitively priced computers, can be provided while maintaining the full amplifier capacity.

Not only can a greater number of flip-flops and logic gates be provided, but a much more flexible time event control is offered. The Model 3328 incorporates a crystal controlled 1 Kc output and can be patched, using up to six decade dividers to provide an unlimited number of outputs in 1 ms steps to 999 seconds. The same decade divider arrangement can provide the same range of outputs as a function of events within the program, such as Max-Min and inflection points. Since the six decade dividers are independently patchable, there is complete flexibility of use between event and timer dividers. This flexible unit, in conjunction with the Model 3327 logic gates and the Model 3326 flip-flops, provides control capability that is only limited by the imagination of the user.

Programming - Module Flexibility

S-D 40/80 The Model 3320 is our Dual Integrator module. On the problem board we have the following layout:



S-D 10/20 The Model 3329 QUAD Integrator provides the same patching flexibility when used with the Model 3325 QUAD Summer.

- a. Time Scale Mode: The feedback capacitors are in an oven and give you a .01% computing capability.
- b. In our concept, we offer time scale selection independent of computer mode control.
- c. The selection of time scale is normally controlled by a switch on the console marked "Time Scale A-B", also it can be controlled automatically by the problem.
- d. Let's look for a second at the patching flexibility that the operator has for time scale. We can patch a 10th μ to Point B; a 1 μ to Point A; or for some integrators, a 1 μ to Point B and a 10th μ to Point A; or even have other integrators with the feedback capacitor patched around the time scale selector switch.

As you can see from this selection of patching, the operator has complete control, either manually or automatically, of time scale during a problem solution.

- e. In the integrator mode control, we use high-speed reed relays. The top of the relay coil for the reset and hold relays is terminated at the board next to each integrator. On either side of these terminations, we terminate for patching purposes the reset and hold bus. Therefore, with a simple patch you can put the integrator in any mode: Computer, Reset, Hold, Track and Store, etc., during any part of the problem mode. This type of arrangement allows the operator to program for the most complex iterative problem program. He also has the complete flexibility to do any kind of complicated subroutine within a Rep-Op or Real Time computation.
- f. The operator can also simply patch the integrator so that its mode control is done by electronic switches rather than the high-speed relays. With electronic mode control, the operator now has all of the flexibility to solve problems involving high speed iteration or Rep-Op.
- g. High speed repetitive operation is provided as a standard feature of the S-D Computers. Continuously adjustable control of compute time is provided from 5 msec to 10 seconds. The reset period in the S-D 40/80 is continuously adjustable in the range from 5 msec to 5 seconds. This control, in conjunction with the high speed reed relays of the computing modules, provides repetitive operation speeds up to 100 cps. There is full flexibility in the selection of time scale for any of the combinations of compute and reset time. This flexibility allows full use of the high accuracy integrator capacitors for improved computational results. By using the Model 3324 modules, repetitive operation speeds up to 1 Kc can be provided.

OTHER FEATURES

We have static and dynamic problem check. (S-D 40/80 only)

Without removing any patch cards, you can:

Check all patching,

Check all IC's,

Check all integrator timing as used in the problem.

In the S-D 40/80 and S-D 10/20 --

You receive a complete digital address system.

You have three different time scale selections that are independent from the compute mode and can be programmed independently for each integrator.

Our standard integrator can be used with electronic mode control for high speed Rep-Op and can be programmed in a forward or reverse mode.

Computing modules can be placed anywhere in the system by the user without any modification to the system.

We have nine different computing modules on the market, with seven more in their final stages of development. Within a year we will have more than twenty different computing modules designed for the system so that the customer can add them without any changes to the computer. In the enclosed literature, you will find a complete selection of computing elements --

Integrators	Function Relays	Comparators
Summers	Multipliers	Event Counters
Inverters	Dividers	Clock Counters
Function Generators	Electronic Switches	RST Flip-Flops
		Electronic Gates

--- With more to come (emphasizing cost, accuracy, and computing capability, digital and analog).

Expansion Capabilities

S-D 40/80	Expands to 84 Amplifiers
S-D 10/20	Expands to 20 Amplifiers

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August 5, 1965